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x suppressed to meet the confidentiality requirements of the *Statistics Act*
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Abstract

Background: Living in a community with lower socioeconomic status is associated with higher mortality. However, few studies have examined associations between community socioeconomic characteristics and mortality among the First Nations population.

Data and methods: The 1991-to-2006 Census Mortality and Cancer Cohort follow-up, which tracked a 15% sample of Canadians aged 25 or older, included 57,300 respondents who self-identified as Registered First Nations people or Indian band members. The Community Well-Being Index (CWB), a measure of the social and economic well-being of communities, consists of income, education, labour force participation, and housing components. A dichotomous variable was used to indicate residence in a community with a CWB score above or below the average for First Nations communities. Age-standardized mortality rates (ASMRs) were calculated for First Nations cohort members in communities with CWB scores above and below the First Nations average. Cox proportional hazards models examined the impact of CWB when controlling for individual characteristics.

Results: The ASMR for First Nations cohort members in communities with a below-average CWB was 1,057 per 100,000 person-years at risk, compared with 912 for those in communities with an above-average CWB score. For men, living in a community with below-average income and labour force participation CWB scores was associated with an increased hazard of death, even when individual socioeconomic characteristics were taken into account. Women in communities with below-average income scores had an increased hazard of death.

Interpretation: First Nations people in communities with below-average CWB scores tended to have higher mortality rates. For some components of the CWB, effects remained even when individual socioeconomic characteristics were taken into account.

Keywords: Aboriginal health, age-standardized mortality rates, cohort studies, community, data linkage, indigenous, longitudinal studies, rate ratios, socioeconomic

Aboriginal groups in Canada experience higher rates of mortality and morbidity than do non-Aboriginal people.[1-4] A number of studies have compared the health status of Aboriginal and non-Aboriginal populations,[1,5] but few have explored the broader determinants of health and mortality among Aboriginal populations.[6]

Lower socioeconomic status, measured by variables such as income, education and employment, is associated with higher levels of mortality.[7,8] High mortality rates among the First Nations population can be partially explained by individual socioeconomic characteristics, but differences persist when these factors are taken into account.[1,9]

A growing body of research has examined the impact of community characteristics on health.[10] Residing in a low-income neighbourhood or community has been associated with poorer health outcomes and increased mortality.[11-13] However, studies specifically examining the impact of community characteristics on health outcomes among Aboriginal populations in Canada are rare. One analysis based on the Aboriginal Children's Survey found that off-reserve First Nations people in neighbourhoods with a higher percentage of renters tended to have poorer mental health even when the influence of individual and family socioeconomic factors was controlled.[14] Several studies have linked overcrowding, isolation, income, and community control in First Nations communities with outcomes such as tuberculosis, hepatitis A, and hospitalizations.[15-17] However, these studies did not examine the impact of individual and community characteristics simultaneously.

The Community Well-Being index (CWB) contains education, labour force, income, and housing components.[18] This study uses the 1991-to-2006 Census Mortality and Cancer Cohort to assess the influence of community factors as measured by the CWB and individual characteristics on the mortality of individuals who identified as Registered First Nations people or Indian band members.

Data and methods

Data

The data are from the 1991-to-2006 Census Mortality and Cancer Cohort, a 15% sample (n = 2,735,150) of the non-institutional population aged 25 or older.[7] The cohort was tracked for mortality from June 4, 1991 through December 31, 2006.

Respondents to the 1991 Census long-form questionnaire were eligible to be linked to the Canadian Mortality Database using a probabilistic linkage, as names were not captured on the census database. Eligible census respondents were linked to a 1990 and 1991 nominal tax-filer data list that contained common variables (date of birth, postal code, spousal date of birth) and encrypted names. The census and encrypted names were linked to the Canadian Mortality Database. Because encrypted names were required from the tax-filer data, only tax-filers could be followed for mortality. The probabilistic linkage meant that all groups were not equally likely to be linked. Specifically, people reporting Aboriginal ancestry were less likely to be linked than were those with non-Aboriginal ancestry.[19]

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Eligibility

Everyone aged 25 or older enumerated by the 1991 Census long-form was eligible to be part of the cohort. In most of Canada, the long-form questionnaire was administered to one in five households, but it was administered on a 100% basis to residents of several remote and northern communities, Indian reserves and settlements, and non-institutional collective dwellings. However, 78 Indian reserves and settlements, with a population of approximately 38,000, were not enumerated or incompletely enumerated, and thus, could not be included in the cohort.

Data quality reports found that 3.4% of Canadian residents were missed by the 1991 Census. Compared with the enumerated population, these people were more likely to be young, mobile, low-income, homeless, or of Aboriginal ancestry.[20]

The present analysis is based on 57,300 cohort members who, on the 1991 Census, reported that they were members of an Indian band or a Registered Indian as defined by the *Indian Act*. Throughout the remainder of this study, they are referred to as Registered First Nations people. Cohort members who reported their ethnic origin (ancestry) as North American Indian, but did not report membership in an Indian band or being a Registered Indian, were not included.

Individual characteristics

Socioeconomic characteristics of individuals were derived from the 1991 Census: marital status, labour force status, income quintile, educational attainment, and housing quality. Three marital status categories were specified: legally married/common-law, divorced/separated/widowed, and single. Three categories of labour force status were used: employed, unemployed, and not in the labour force. The measure of income was based on quintiles of economic family income; to account for regional differences in income, quintiles were constructed within each Census Metropolitan Area (CMA)/Census Agglomeration (CA) and in all other areas.

Highest level of educational attainment was grouped into four categories: less than secondary school graduation, secondary school graduation, some post-secondary, and university degree.

Housing quality was assessed by a dichotomous variable indicating if respondents lived in a dwelling that needed major repairs.

To track residential mobility, individual census records were linked to postal code data obtained from tax files submitted between 1990 and 2007. For 76.7% of cohort members, complete postal code information was available from the tax-filer data. Among most (99.8%) of those with incomplete information, postal code could be imputed from previous tax-filer years; information for the remaining 0.2% was imputed from census data.[19] A change in postal code over the 16-year follow-up signalled a residential move. Three categories were created: non-movers; short movers (within a Census Subdivision or Census Division); and long movers (across Census Divisions or provinces). This does not cover all moves. Because some Indian Reserves/Settlements and small municipalities have a single postal code, moves within these areas would be missed. As well, multiple moves within a single year, or if the tax-filer used a previous address (not the actual address), could not be detected.

Community measures

The Community Well-Being index (CWB) measures the social and economic well-being of communities based on data from the Census of Canada.[18] The CWB is calculated at the Census Subdivision (CSD) level. The CWB consists of seven indicators in four equally weighted components: education, income, labour force activity, and housing. These indicators are also important determinants of health.[21] The seven CWB indicators are combined into an index between 0 and 100.

For the population aged 20 or older, the CWB education component identifies the percentage whose highest level of attainment is at least secondary graduation, and for the population aged 25 or older, the percentage with at least a university degree. The labour force component consists of labour force participation and percentage of the labour force who are employed or unemployed. The income component is income per capita, calculated as total community income divided by total population. The housing component is comprised of an indicator of crowding (percentage of population in dwellings with more than one person per room) and an indicator of dwelling quality (percentage in dwellings that need major repairs). Information about the CWB and its application to the First Nations population is available elsewhere.[18,21-24] The CWB is analysed as a dichotomous variable using the average for First Nations communities in 1991 as a cut-point.

Metropolitan Influence Zone (MIZ) was used to assess the remoteness of a municipality. MIZ assigns a category to municipalities outside a CMA/CA based on the percentage of the employed labour force who commute to work in the CMA/CA. The four categories are: strong, moderate, weak or no MIZ. People living in a moderate or strong MIZ were combined into a single category because preliminary models indicated that mortality did not differ significantly between them.

Age-standardized mortality rates

Age-standardized mortality rates (ASMRs) were calculated per 100,000 person-years at risk by sex for individual and community variables, using the direct method. The population for age-standardization was the age distribution, in five-year age groups, of cohort members who self-identified as Registered Indians under the *Indian Act*, were members of an Indian band/First Nation, or had Aboriginal ancestry. Variances derived with the Spiegelman method were used to calculate confidence intervals.[25]

Table 1
Descriptive statistics, Registered First Nations of 1991-to-2006 Census Mortality and Cancer Cohort, 1991

	Men		Women	
	Number	Percent	Number	Percent
Total	24,900	100	32,400	100
Average age (years)	40.3 (SD 12.9)	...	39.7 (SD 12.6)	...
Died during follow-up	4,000	16	3,800	12
Marital status				
Single	5,400	22	5,100	16
Married/Common-law	17,000	69	22,200	68
Divorced/Widowed	2,400	10	5,100	16
Income quintile				
1 (lowest)	9,800	40	13,700	42
2	6,400	26	8,100	25
3	4,300	17	5,400	17
4	2,900	12	3,400	11
5 (highest)	1,400	6	1,700	5
Educational attainment				
Less than secondary school graduation	14,800	60	18,200	56
Secondary school graduation	8,000	32	9,200	28
Some postsecondary	1,700	7	4,100	13
University degree or more	400	2	900	3
Labour force status				
Employed	12,500	50	13,100	40
Unemployed	5,300	21	3,500	11
Not in labour force	7,100	29	15,800	49
Dwelling in need of major repair				
No	16,300	65	21,700	67
Yes	8,600	35	10,700	33
Move distance				
Non-mover	12,400	50	15,800	49
Within Census Subdivision/Census Division	7,400	30	9,900	31
Across Census Division/Province	5,100	20	6,600	20
Metropolitan Influence Zone (MIZ)				
Census Metropoitan Area (CMA)	5,800	23	8,600	26
Moderate/Strong	4,200	17	5,300	16
Weak	8,600	35	1,110	34
No	6,300	25	7,400	23
1991 Community Well-Being Index (CWB) score				
Above average for First Nations communities	13,300	54	18,200	56
Below average for First Nations communities	11,500	46	14,200	44
Income component				
Above average for First Nations communities	14,400	54	18,100	59
Below average for First Nations communities	11,500	46	13,300	41
Education component				
Above average for First Nations communities	13,800	56	19,100	59
Below average for First Nations communities	11,000	44	13,300	41
Labour force activity component				
Above average for First Nations communities	13,700	55	18,800	58
Below average for First Nations communities	11,100	45	13,600	42
Housing component				
Above average for First Nations communities	13,700	55	18,600	57
Below average for First Nations communities	11,100	45	13,800	43
Average 1991 CWB score				
Total	55 (SD 13)	...	57 (SD 14)	...
Income component	55 (SD 17)	...	57 (SD 17)	...
Education component	27 (SD 13)	...	28 (SD 14)	...
Labour force component	69 (SD 12)	...	70 (SD 12)	...
Housing component	70 (SD 17)	...	71 (SD 18)	...

... not applicable
SD = standard deviation
Source: 1991-to-2006 Census Mortality and Cancer Cohort.

Cox proportional hazards models

For in-scope cohort members, person-days of follow-up were calculated from baseline (June 4, 1991) to the date of death, emigration, or end of the study (December 31, 2006). Cox proportional hazards survival models were used to examine the influence of community factors and individual characteristics on mortality among Registered First Nations cohort members.[26]

Three sets of models were run. The first set included only the CWB components; the second, only individual characteristics. The purpose of these models was to examine the effects of community and individual characteristics separately.

The third set of models consisted of both the CWB components and individual characteristics in order to determine the extent to which the effects of CWB indicators are attenuated with the addition of individual characteristics.

All models were stratified by sex and five-year age group. Ties were handled using the Efron method.[27]

Results

First Nations cohort members

At baseline (June 4, 1991), the average age of Registered First Nations cohort members was 40.3 years for men and 39.7 years for women (Table 1). By the end of the follow-up period (December 31, 2006), 16% of the men and 12% of the women had died. Equal percentages of men and women were married (69% and 68%, respectively); men were less likely than women to be divorced or widowed (10% versus 16%), but more likely to be single (22% versus 16%). About 5% of Registered First Nations cohort members were in the highest income quintile, and around 40% were in the lowest. A majority (60% of men and 56% of women) were not secondary school graduates. Half (50%) of men were employed, and 21% were unemployed; the corresponding figures for women were 40% and 11%. A higher percentage of women than men were not in the labour force (49% versus 29%).

About three-quarters of cohort members lived in crowded dwellings, and two-thirds were in dwellings that needed major repairs.

By the end of follow-up, 30% of Registered First Nations cohort members had moved within a Census Division, and 20% had moved from one Census Division or province/territory to another.

Age-standardized mortality rates

In 1991, the ASMR for cohort members in communities below the First Nations CWB average was 1,056.6 per 100,000, compared with 912.1 for those in communities above the First Nations average (Table 2). The rate ratio was 1.16, indicating that the mortality rate was 16% higher among those in communities with a below-average CWB score.

Examination of the CWB components separately shows that living in communities with a below-average education score was associated with a 9% higher mortality rate overall. Differences were not significant for male cohort members, but female cohort members in communities with a below-average CWB education score had an 11% higher mortality rate.

The mortality rate for people in communities with below-average income components was 24% higher than for those in communities with above-average income components. Living in a community with a below-average labour force participation component was associated with a 17% higher mortality rate. These differences by income and labour force components prevailed for both sexes.

Mortality rates of residents of communities with above- or below-average housing components did not differ significantly.

Table 2
Age-standardized and crude mortality rates per 100,000 person-years at risk and rate ratios, by sex and Community Well-Being (CWB) component score, Registered First Nations members of 1991-to-2006 Census Mortality and Cancer Cohort

Sex, CWB component	Number of deaths	Age-standardized mortality rate	95% confidence interval		Crude mortality rate	Rate ratio	95% confidence interval	
			from	to			from	to
Total								
Total - Below	3,853	1,056.6	1,023.7	1,090.6	1,047.7	1.16	1.11	1.21
Total - Above	4,016	912.1	884.1	941.0	894.5	1.00	...	...
Education - Below	3,488	1,022.3	988.9	1,056.8	1,003.7	1.09	1.04	1.13
Education - Above	4,381	942.0	914.4	970.5	933.7	1.00	...	...
Income - Below	3,937	1,094.9	1,061.1	1,129.7	1,074.9	1.24	1.19	1.30
Income - Above	3,932	880.3	853.1	908.4	872.9	1.00	...	...
Labour force - Below	3,713	1,065.1	1,031.3	1,100.0	1,053.3	1.17	1.12	1.23
Labour force - Above	4,156	908.1	880.8	936.2	895.3	1.00	...	...
Housing - Below	3,480	993.8	961.3	1,027.5	975.6	1.03	0.99	1.08
Housing - Above	4,389	963.6	935.3	992.7	954.1	1.00	...	...
Men								
Total - Below	2,023	1,229.3	1,176.7	1,284.3	1,249.0	1.14	1.07	1.21
Total - Above	2,014	1,081.7	1,035.0	1,130.5	1,084.2	1.00	...	...
Education - Below	1,842	1,173.1	1,120.6	1,228.1	1,189.9	1.04	0.98	1.11
Education - Above	2,195	1,128.0	1,081.4	1,176.7	1,137.7	1.00		
Income - Below	2,061	1,290.1	1,235.5	1,347.2	1,287.4	1.26	1.18	1.34
Income - Above	1,976	1,025.1	980.6	1,071.6	1,053.1	1.00	...	...
Labour force - Below	1,947	1,248.5	1,194.1	1,305.4	1,250.9	1.17	1.10	1.24
Labour force - Above	2,090	1,067.1	1,022.1	1,114.1	1,088.1	1.00	...	...
Housing - Below	1,837	1,153.5	1,101.8	1,207.7	1,174.8	1.01	0.95	1.07
Housing - Above	2,200	1,146.9	1,099.5	1,196.3	1,149.7	1.00	...	...
Women								
Total -Below	1,830	919.5	878.2	962.7	889.3	1.16	1.09	1.24
Total - Above	2,002	790.8	756.6	826.6	760.6	1.00	...	...
Education - Below	1,646	898.9	856.4	943.6	854.2	1.11	1.04	1.18
Education - Above	2,186	810.4	776.8	845.4	791.2	1.00		...
Housing - Below	1,643	866.4	825.3	909.5	820.1	1.04	0.98	1.11
Housing - Above	2,189	830.9	796.6	866.7	814.9	1.00	...	...
Income - Below	1,876	942.6	900.8	986.4	909.9	1.22	1.15	1.30
Income - Above	1,956	771.2	737.5	806.3	744.3	1.00	...	...
Labour force - Below	1,766	917.5	875.5	961.5	897.1	1.16	1.09	1.23
Labour force - Above	2,066	792.3	758.7	827.4	759.2	1.00	...	...
Housing - Below	1,643	866.4	825.3	909.5	820.1	1.04	0.98	1.11
Housing - Above	2,189	830.9	796.6	866.7	814.9	1.00	...	...

... not applicable
Note: Above/Below was based on 1991 average CWB score for First Nations communities.
Source: 1991-to-2006 Census Mortality and Cancer Cohort.

Cox proportional hazards models

A series of Cox proportional hazards models demonstrates how the CWB components and the socioeconomic characteristics of individuals were associated with the hazard of death among Registered First Nations cohort members over the 1991-to-2006 period.

Model 1 contains only the CWB components (Table 3). Living in a community with a below-average overall CWB index score increased the hazard of death by 14% for men, and by 17% for women. A below-average community score on the CWB education component raised women's hazard of death by 11%, but no significant effects emerged for men. Residing in a community with a below-average CWB income score was associated with a 27% increase in the hazard of death for men and a 24% increase for women. For both sexes, a below-average CWB labour force score raised the hazard of death by approximately 17%. The CWB housing component was not associated with mortality for either sex, and was, therefore, excluded from subsequent models.

Model 2 contains only the individual-level characteristics, most of which were significant in the expected direction (Table 4). Compared with being married, being single or divorced/widowed was associated with an increased hazard

of death for both sexes. Education was also significant—those with less than secondary school graduation had an increased hazard of death, compared with those reporting higher attainment. Similarly, relative to being employed, being unemployed or not in the labour force increased the hazard of death for both sexes. Being in the lowest income quintile, rather than in the three highest, raised the hazard of death for both sexes. Also, being in the second-lowest income quintile was significantly associated with an increased hazard of death for women, but not for men. Living in a dwelling that needed major repairs was related to an increased hazard of death for women, but not for men.

Table 3
Model 1: Cox survival model predicting hazard of death, by Community Well-Being (CWB) components, Registered First Nations members of 1991-to-2006 Census Mortality and Cancer Cohort

	Men				Women			
	Hazard ratio				Hazard ratio			
		95% confidence interval				95% confidence interval		
CWB components		from	to	Pr > ChiSq		from	to	Pr > ChiSq
Total	1.143†	1.075	1.216	<.0001	1.168†	1.097	1.245	<.0001
Education	1.042	0.980	1.109	0.1888	1.113†	1.044	1.186	0.0011
Income	1.267†	1.191	1.348	<.0001	1.236†	1.160	1.316	<.0001
Labour force activity	1.171†	1.101	1.246	<.0001	1.168†	1.096	1.245	<.0001
Housing	1.004	0.944	1.069	0.889	1.044	0.979	1.113	0.1877

† significantly different from those in communities with CWB scores above average for First Nations communities
Notes: CWB components were dichotomized based on the average for First Nations communities in 1991. The ratios refer to the hazard of death associated with living in a community with a below-average CWB score.
Source: 1991-to-2006 Census Mortality and Cancer Cohort.

Table 4
Model 2: Cox survival model predicting hazard of death, by individual characteristics, Registered First Nations members of 1991-to-2006 Census Mortality and Cancer Cohort

	Men				Women			
	Hazard ratio				Hazard ratio			
		95% confidence interval				95% confidence interval		
Individual characteristics		from	to	Pr > ChiSq		from	to	Pr > ChiSq
Single versus married	1.476†	1.359	1.603	<.0001	1.305†	1.176	1.449	<.0001
Divorced/Widowed versus married	1.350†	1.242	1.467	<.0001	1.214†	1.122	1.313	<.0001
Less than secondary graduation versus higher attainment	1.117†	1.034	1.208	0.0051	1.344†	1.232	1.466	<.0001
Unemployed versus employed	1.182†	1.068	1.308	0.0012	1.337†	1.152	1.551	0.0001
Not in labour force versus employed	1.653†	1.517	1.801	<.0001	1.723†	1.568	1.892	<.0001
Income quintile 1 (lowest) versus quintiles 3/4/5	1.240†	1.145	1.342	<.0001	1.263†	1.159	1.378	<.0001
Income quintile 2 versus quintiles 3/4/5	1.083	0.995	1.179	0.0641	1.171†	1.069	1.283	0.0007
Dwelling needs major repair	1.036	0.972	1.105	0.2756	1.098†	1.028	1.173	0.0054
Short move since 1991	0.767†	0.71	0.827	<.0001	0.812†	0.751	0.877	<.0001
Long move since 1991	1.049	0.964	1.142	0.2679	1.075	0.983	1.175	0.1149
Weak Metropolitan Influence Zone (MIZ)	0.949	0.882	1.021	0.1617	0.996	0.925	1.073	0.9185
No MIZ	0.906†	0.837	0.982	0.0161	0.932	0.856	1.014	0.103

† significantly different hazard of death
Source: 1991-to-2006 Census Mortality and Cancer Cohort.

Compared with not moving, a short move during the past 16 years was related to a lower hazard of death for both sexes; long moves were not associated with a higher or lower hazard of death. Living in weak MIZ rather than in a CMA or a moderate or strong MIZ was not associated with an increased hazard of death. However, residence in an area that was not a MIZ was associated with a reduced risk of mortality among men, but not women.

Model 3 (Table 5) contains the CWB values and the full set of individual characteristics. Model 3A shows that the overall CWB score was no longer significantly associated with mortality when individual socioeconomic characteristics were considered. However, the picture differs for specific CWB components.

Model 3B shows that living in a community with a below-average CWB income score was associated with an increased hazard of death for men (20%) and women (15%), even when accounting for individual socioeconomic characteristics. By contrast, with the addition of individual socioeconomic characteristics, the CWB education component was no longer significant for women (Model 3C). According to model 3D, residence in a community with a below-average CWB labour force score was associated with an increase (7%) in the hazard of death for men, but not for women.

Discussion

This study examines how community socioeconomic indicators and individual characteristics were associated with mortality among a large sample of Registered First Nations people.

Mortality was 16% higher among residents of communities with a CWB index score below the average for First Nations communities. For both sexes, living in communities with below-average CWB income and labour force scores was associated with increased mortality. As well, for women, living in communities with below-average CWB

Table 5
Model 3: Cox survival models predicting hazard of death among Registered First Nations members of 1991-to-2006 Census Mortality and Cancer Cohort, controlling for Community Well-Being (CWB) components and individual characteristics

	Men				Women			
	Hazard ratio				Hazard ratio			
		95% confidence interval				95% confidence interval		
Individual characteristics, CWB components		from	to	Pr > ChiSq		from	to	Pr > ChiSq
A. Total CWB								
Single versus married	1.480†	1.363	1.608	<.0001	1.306†	1.177	1.450	<.0001
Divorced/Widowed versus married	1.352†	1.244	1.469	<.0001	1.218†	1.126	1.317	<.0001
Less than secondary graduation versus higher attainment	1.110†	1.027	1.200	0.0088	1.337†	1.225	1.458	<.0001
Unemployed versus employed	1.179†	1.065	1.304	0.0015	1.333†	1.149	1.547	0.0002
Not in labour force versus employed	1.639†	1.503	1.787	<.0001	1.710†	1.556	1.879	<.0001
Income quintile 1 (lowest) versus quintiles 3/4/5	1.239†	1.144	1.342	<.0001	1.265†	1.160	1.379	<.0001
Income quintile 2 versus quintiles 3/4/5	1.080	0.992	1.176	0.0745	1.168†	1.066	1.279	0.0008
Dwelling needs major repair	1.028	0.963	1.097	0.4032	1.090†	1.020	1.166	0.0114
Short move since 1991	0.770†	0.713	0.831	<.0001	0.815†	0.754	0.881	<.0001
Long move since 1991	1.049	0.964	1.142	0.2668	1.080	0.987	1.182	0.0932
Weak Metropolitan Influence Zone (MIZ)	0.938	0.871	1.011	0.0946	0.988	0.916	1.066	0.7551
No MIZ	0.888†	0.816	0.965	0.0054	0.914	0.835	1.000	0.0498
CWB total	**1.057**	**0.988**	**1.131**	**0.1097**	**1.048**	**0.976**	**1.126**	**0.1951**
B. CWB income								
Single versus married	1.490†	1.372	1.619	<.0001	1.307†	1.178	1.451	<.0001
Divorced/Widowed versus married	1.349†	1.241	1.466	<.0001	1.223†	1.131	1.323	<.0001
Less than secondary graduation versus higher attainment	1.107	1.024	1.197	0.0104	1.335†	1.223	1.456	<.0001
Unemployed versus employed	1.178	1.065	1.304	0.0015	1.332†	1.147	1.545	0.0002
Not in labour force versus employed	1.612†	1.479	1.757	<.0001	1.689†	1.537	1.856	<.0001
Income quintile 1 (lowest) versus quintiles 3/4/5	1.228†	1.134	1.330	<.0001	1.262†	1.157	1.376	<.0001
Income quintile 2 versus quintiles 3/4/5	1.071	0.984	1.165	0.1151	1.159†	1.058	1.270	0.0015
Dwelling needs major repair	1.018	0.954	1.086	0.5959	1.078†	1.008	1.153	0.0272
Short move since 1991	0.769†	0.713	0.830	<.0001	0.815†	0.754	0.881	<.0001
Long move since 1991	1.041	0.956	1.133	0.3561	1.084	0.991	1.185	0.0788
Weak Metropolitan Influence Zone (MIZ)	0.927†	0.861	0.998	0.0448	0.980	0.909	1.056	0.5909
No MIZ	0.854†	0.786	0.928	0.0002	0.883†	0.807	0.965	0.006
CWB income	**1.198†**	**1.122**	**1.279**	**<.0001**	**1.150†**	**1.073**	**1.232**	**<.0001**
C. CWB education								
Single versus married	1.474†	1.357	1.601	<.0001	1.305†	1.175	1.448	<.0001
Divorced/Widowed versus married	1.349†	1.241	1.466	<.0001	1.213†	1.122	1.312	<.0001
Less than secondary graduation versus higher attainment	1.122†	1.037	1.214	0.0041	1.345†	1.232	1.469	<.0001
Unemployed versus employed	1.182†	1.068	1.308	0.0012	1.337†	1.152	1.551	0.0001
Not in labour force versus employed	1.657†	1.521	1.806	<.0001	1.724†	1.569	1.893	<.0001
Income quintile 1 (lowest) versus quintiles 3/4/5	1.240†	1.145	1.342	<.0001	1.263†	1.158	1.378	<.0001
Income quintile 2 versus quintiles 3/4/5	1.084	0.996	1.18	0.0614	1.171†	1.069	1.283	0.0007
Dwelling needs major repair	1.038	0.973	1.108	0.2534	1.099†	1.028	1.174	0.0054
Short move since 1991	0.766†	0.709	0.826	<.0001	0.811	0.751	0.877	<.0001
Long move since 1991	1.05	0.965	1.143	0.2605	1.074	0.982	1.175	0.1171
Weak Metropolitan Influence Zone (MIZ)	0.957	0.886	1.033	0.2611	0.998	0.923	1.08	0.9616
No MIZ	0.918	0.841	1.001	0.0532	0.935	0.851	1.027	0.1583
CWB education	**0.975**	**0.909**	**1.047**	**0.4883**	**0.994**	**0.922**	**1.072**	**0.8776**
D. CWB labour force activity								
Single versus married	1.479†	1.362	1.607	<.0001	1.305†	1.176	1.449	<.0001
Divorced/Widowed versus married	1.351†	1.243	1.469	<.0001	1.215†	1.124	1.314	<.0001
Less than secondary graduation versus higher attainment	1.114†	1.031	1.204	0.0065	1.341†	1.229	1.463	<.0001
Unemployed versus employed	1.172†	1.059	1.297	0.0022	1.330†	1.146	1.544	0.0002
Not in labour force versus employed	1.631†	1.495	1.778	<.0001	1.709†	1.555	1.879	<.0001
Income quintile 1 (lowest) versus quintiles 3/4/5	1.237†	1.142	1.340	<.0001	1.263†	1.158	1.377	<.0001
Income quintile 2 versus quintiles 3/4/5	1.079	0.991	1.174	0.0794	1.168†	1.066	1.279	0.0009
Dwelling needs major repair	1.029	0.965	1.098	0.3838	1.092†	1.022	1.168	0.0097
Short move since 1991	0.77†	0.713	0.831	<.0001	0.815†	0.754	0.881	<.0001
Long move since 1991	1.051	0.966	1.144	0.2493	1.080	0.987	1.182	0.0935
Weak Metropolitan Influence Zone (MIZ)	0.942	0.875	1.014	0.1107	0.992	0.921	1.069	0.8356
No MIZ	0.891†	0.821	0.967	0.0058	0.922	0.845	1.005	0.0662
CWB labour force activity	**1.069†**	**1.001**	**1.141**	**0.0453**	**1.042**	**0.974**	**1.115**	**0.2338**

† significantly different hazard of death

Notes: CWB components were dichotomized based on the average for First Nations communities in 1991. The ratios for CWB components refer to the hazard of death associated with living in a community with a below-average CWB score.

Source: 1991-to-2006 Census Mortality and Cancer Cohort.

education scores was associated with increased mortality. However, these results do not consider the influence of individual characteristics.

What is already known on this subject?

- Living in a community with lower socioeconomic status is associated with higher mortality.
- Aboriginal groups experience higher rates of mortality than do non-Aboriginal people.
- Few studies have specifically examined the impact of community characteristics on mortality among Aboriginal populations in Canada.

What does this study add?

- The Community Well-Being index (CWB) is a measure of social and economic conditions incommunities; it consists of education, labour force, income, and housing components.
- Based on data for the 1991-to-2006 Census Mortality and Cancer Cohort, this study examines the influence of community factors as measured by the CWB and individual characteristics on the mortality of individuals identified as Registered First Nations people or Indian band members.
- Living in a community with a below-average score on the CWB income component was associated with an increased hazard of death for men (20%) and women (15%), even when individual socioeconomic characteristics were taken into account.
- For men, regardless of individual socioeconomic characteristics, residence in a community with a below-average score on the CWB labour force component was associated with an increase (7%) in the hazard of death; this was not the case for women.

Consistent with previous work,[28,29] individual characteristics—income, educational attainment, and employment—were also associated with mortality among First Nations cohort members. A 2009 study showed that adjusting for socioeconomic factors reduced the mortality hazard ratios between Registered Indians and non-Aboriginal people.[5] As well, a 2010 analysis of self-reported survey data found that adjusting for income and education reduced, but did not eliminate, the health disparity between Aboriginal and non-Aboriginal respondents.[9] In the present study, when individual characteristics were included in the analysis, the overall CWB index score was no longer significant. Similar results have been reported using survey data.[30,31]

In the calculation of ASMRs and in the survival models, the CWB housing component was not associated with mortality. According to the model that contained only individual characteristics, "dwelling in need of repairs" increased the hazard of death for women; the "crowding" variable was not included, as preliminary models showed few significant results. Using the same cohort, Tjepkema et al.[32] reported that adjusting for housing conditions (crowding, home ownership, major repairs) at the individual level did not reduce the hazard ratio for premature death for Status Indians living on reserve.

Registered First Nations cohort members who moved a short distance during the 16-year follow-up period had a reduced hazard of death. Motivations for moving are not known, but people who move within a CD may be doing so for reasons associated with lower mortality (for example, employment). Almost two-thirds (63%) of Registered First Nations cohort members who were non-movers had not completed secondary school, compared with 52% of those who moved a short distance. Because individual socioeconomic characteristics are available only at baseline, it is not possible to determine if moving coincided with changes in characteristics such as income, education, or employment. However, an international longitudinal study reported that working-age rural-to-urban migrants experienced lower mortality than did non-migrants.[33]

Strengths and limitations

A strength of this study is the use of a large census-linked dataset containing more than 50,000 Registered First Nations respondents. Linkage to tax data over the 16-year follow-up allowed tracking of residential mobility.

However, the findings should be considered in the light of several limitations. The study included only individuals enumerated by the 1991 Census long-form—78 Indian reserves with a total population of about 38,000 were either not enumerated or incompletely enumerated, and therefore, were not part of the cohort. As well, 3.4% of Canadian residents were missed by the census and were more likely to be of Aboriginal ancestry.[20] Although census long-form over-sampling of residents of Indian reserves and remote/northern communities means these areas were over-represented in the cohort, those reporting Aboriginal ancestry were the least likely to be linked and included.[19]

Except for the residential mobility variable, individual characteristics were assessed only at baseline by the census long-form. Consequently, information is lacking about subsequent changes in factors such as income, education, or employment, which may influence mortality.

The CWB index has several limitations. CWB scores were assessed only at baseline, and some cohort members may have moved to communities with higher or lower scores. Furthermore, communities themselves may have experienced an increase or decrease in CWB over the study period, which was not taken into account in this analysis. In fact, from 1991 to 2001, CWB scores of First Nations communities increased at

a faster rate than did those in other communities.[18] In addition, the CWB index does not cover traditional economic pursuits that do not directly result in monetary income or paid employment.[18] This study did not capture all community-level factors, such as material resources (libraries, schools, health care services), social support and community control, that may influence health and mortality.[34,35]

Another limitation is that this analysis was unable to use multilevel modelling techniques that take account of the structured nature of the data for individuals nested in communities. Therefore, the variation in mortality attributed to the community level could not be determined.[36] Instead, community-level variables were added at the individual level. Nonetheless, similar techniques have been used with this dataset in provincial analyses.[1]

Conclusion

This study demonstrates that Registered First Nations members of the 1991-to-2006 Census Mortality and Cancer Cohort who lived in communities with a CWB score below the average for First Nations communities had relatively high ASMRs. The relationship persisted for the CWB income and labour force components even when individual socioeconomic characteristics were taken into account. ■

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